LIVE CAPTURE TECHNIQUES FOR THE EUROPEAN RABBIT

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ABSTRACT

Methods for the live capture of rabbits were examined to determine which combination gave the best capture rates. Wire-mesh cage traps with treadle mechanisms were more successful in capturing rabbits than were similar traps operated by an arm trigger mechanism ($P < 0.01$). Diced carrot bait also gave a greater capture rate than did whole carrot ($P < 0.01$). Flexinet electric fencing was used successfully to contain rabbits over 3–5 consecutive days in an area saturated with cage traps, and lead to the capture of a number of individuals not caught by earlier trapping using standard techniques. The electric fence was effective in containing rabbits at voltages as low as 2.0 kilovolts, however the best results were obtained when the fence was operating at 5.0 kilovolts or higher.

INTRODUCTION

In any long-term population study involving live capture of animals, the use of consistent and efficient trapping techniques is essential. Several papers have compared the efficiency of various small mammal traps, and have also provided information on the response of different species, sexes, and age classes of animals to different types of traps (see Wiener and Smith 1972, Shepherd and Williams 1976, Shepherd *et al.* 1978, Getz et al. 1986, Thompson and Macaulay 1987), but few of these studies have concentrated specifically on rabbits (see Rowley 1959, Shepherd *et al.* 1978).

As part of the Cooperative Research Centre for Biological Control of Vertebrate Pest Populations, we have established a three year experiment

in the south west of Western Australia to determine the level of sterility that would need to be imposed on free-ranging female rabbits to cause a population decline. The ability to catch all rabbits is integral to the success of this experiment as we need to surgically sterilise the appropriate portion of each year's female cohort. The refinement of trapping techniques also has relevance to conservation and rabbit control, particularly in urbanised areas where the use of poisons is restricted.

For these reasons, we examined the effectiveness of various trapping methods for the live-capture of rabbits to determine which type of cage trap was the most efficient, and to highlight any effects of trap type on captures of kittens and adult rabbits. We also conducted preliminary investigations on how bait presentation affected trap success, and examined the effectiveness of a rabbit-specific electric fence as a barrier to rabbits.

METHODS

Study Area

The fertility control experiment was undertaken in the southwest of Western Australia, Australia approximately 5 kilometres north-west of Wellstead (34°22'S, 119°2'E). Using conventional rabbit-proof fencing, 12 discrete rabbit populations (sites) have been established by enclosing areas of refuge vegetation (mostly road-side verges) on three sides such that movement of rabbits is only minimally interfered with as they travel out to feed in the pasture adjacent to the open fourth side. These sites are between 320 to 400 m long and 60 to 100 m wide, and a fenced buffer zone extends for at least 300 m on both ends of each unit. Except for three occasions, the rabbit populations used during the comparison of trap types had prior exposure to a variety of capture methods.

Trap Comparisons

We compared two types of wire-mesh

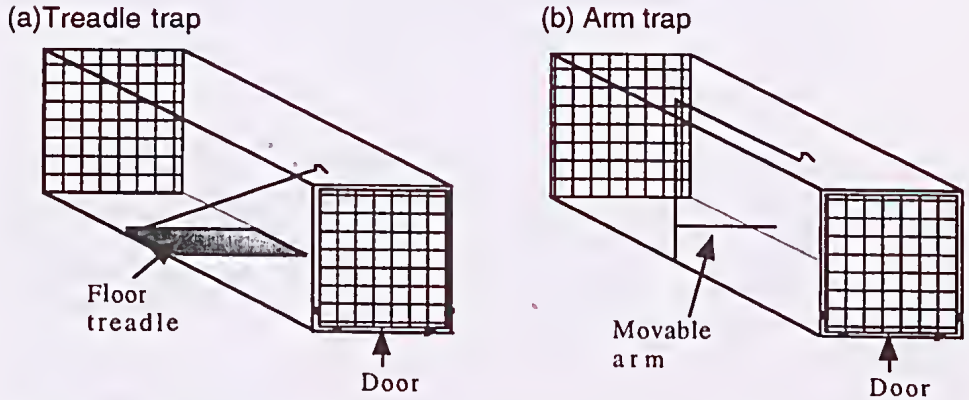


Figure 1. The cage traps used for the efficacy trials. Both trap types measured 480 x 220 x 220 mm and were constructed from 12.5 x 12.5 mm wire mesh.

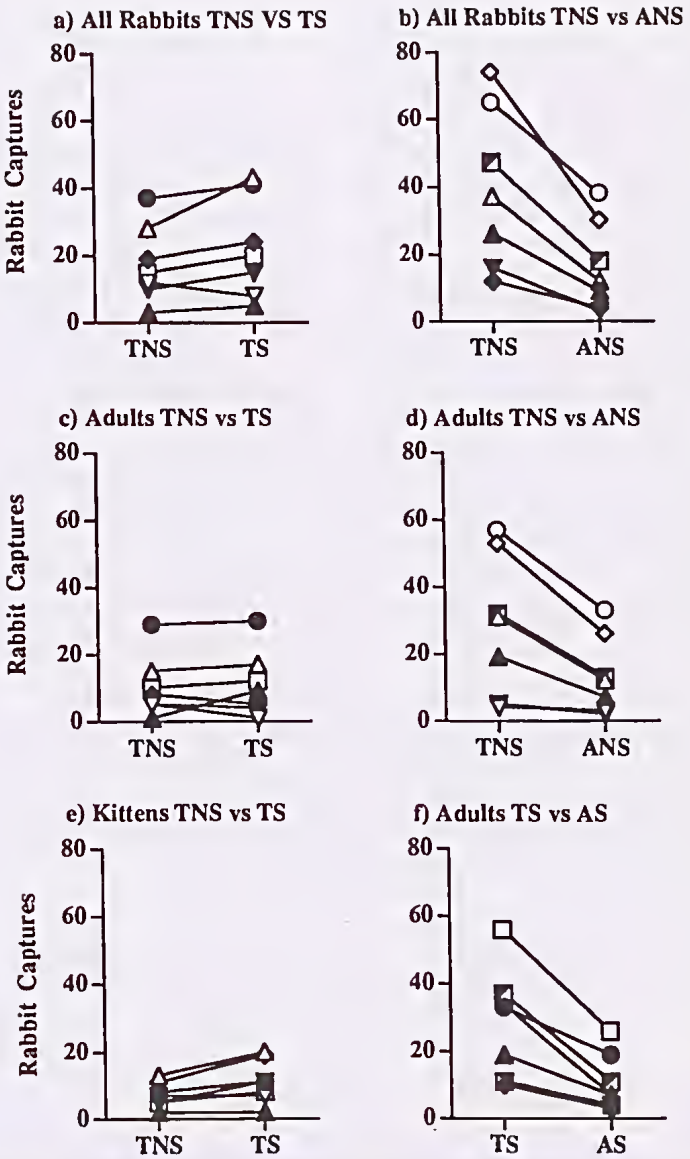
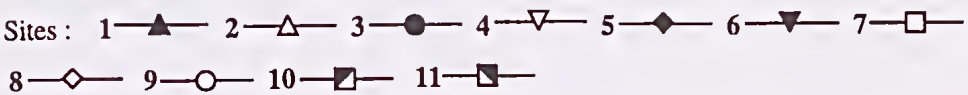


Figure 2. Interaction graphs for each of the trap tests performed. The field tests were undertaken in the south west of Western Australia, Australia during 1992 and 1993. Seven sites (n =7) were used for each test. Comparisons are for all rabbit captures, adult captures only, and kitten captures only for treadle (T) and arm (A) traps with (S) and without (NS) shade cloth.



cage traps: 1) the Commonwealth Scientific Industrial Research Organisation (CSIRO)-designed "arm trap" with a side-mounted wire arm which, when pushed forward, triggers the closure of the door (Fig. 1), and 2) a "treadle trap" of similar design but with a floor mounted treadle door trigger (Fig. 1). Both traps were the same size (580 mm long x 220 mm wide x 220 mm high) and were constructed from 12.5 x 12.5 mm wire mesh. Carrots were used to bait both trap types. We also covered some traps with shade cloth, resulting in four trap variations: treadle with shade cloth (TS), treadle without shade cloth (TNS), arm with shade cloth (AS) and arm without shade cloth (ANS). Only two types of trap (variations) were compared at any one time, with the specific comparisons being TNS vs ANS, TNS vs TS, and TS vs AS.

For each comparison, we placed 20 traps of each type in a grid formation 2 traps wide and 20 traps long with 20 m spacing between traps, ensuring adjacent traps were always of the alternative type.

Traps were set every afternoon, at dusk, for four consecutive days, and checked each morning at day-break. We undertook the comparisons between 2nd September 1992 and 8th February 1993. We only included data for analysis if trap success was less than 70%, which ensured that rabbits used for the comparisons had ample opportunity to enter either trap type. Each comparison was undertaken once only on a site. We also recorded the number of traps entered with the

Table 1. Analysis of Variance (Randomised Block Design) of the different trap types for all rabbit captures, and adults and kittens separately. The field tests were undertaken in the south west of Western Australia during 1992 and 1993. Each comparison was carried out on seven sites with 1 df for each test.
TNS, Treadle trap without shade cloth; TS, treadle trap with shade cloth; ANS, arm trap without shade cloth; AS, arm trap with shade cloth. "False" captures occurred where the bait was removed but the trap was not triggered.

Parameter	Comparison	F	P	Interpretation
All rabbits	TNS vs ANS	26.56	0.01	more captures in TNS
	TNS vs TS	4.63	n. s.	no difference
	TS vs AS	32.76	0.001	more captures in TS
Adults only	TNS vs ANS	15.59	0.01	more captures in TNS
	TNS vs TS	0.23	n. s.	no difference
	TS vs AS	22.29	0.01	more captures in TS
Kittens only	TNS vs ANS	22.63	0.01	more captures in TNS
	TNS vs TS	9.94	0.05	more captures in TS
	TS vs AS	22.70	0.01	more captures in TS
"False" captures	TNS vs ANS	11.74	0.05	more false captures in ANS
	TS vs AS	12.05	0.05	more false captures in AS
"False" plus real captures	TNS vs ANS	2.59	n. s.	no difference
	TS vs AS	0.92	n.s.	no difference

bait removed but not triggered (ie no captures = false captures).

Presentation Of Bait

We consistently use diced carrot as our bait during the sterility trials, and this was the bait used during our trap comparison study. However, we also tested whether diced carrot or whole carrot maximised trap success for our rabbit populations once they were already habituated to carrot bait. Carrots were diced into approximately 1.5 cm cubes (average weight 4.62 ± 1.29 g; n = 40), and the tests were carried out on three of the 12 sites during 19th February to 13th October 1993.

We baited the traps with one of the carrot presentation methods and left every third trap with no bait at all to leave a buffer between each pair of whole and diced carrot treatments. A grid of 4 x 20 plus one extra trap was used and we alternated the three treatments (whole carrot, diced carrot, no bait) such that the type of bait in consecutive traps was always different in either direction. Traps were baited in the late afternoon and checked for captures early the next morning. Only one type of trap was used during each test and all three sites used had been trapped previously.

Electric Fence Trapping

As part of our experimental procedure in the sterility trial, we use an electric fence as a barrier to hold rabbits within their bush refuge away from their normal feeding areas. This enables intensive trapping of the bush refuge at each of our 12 sites to ensure that all rabbits have been captured during the period when sterility is imposed. This occurs during February to March in each year and involves erection of a self-supporting, portable Flexinet Rabbit Netting (distributed by Stafix Electric Fencing Ltd, New Zealand) barrier on the fourth, unfenced side of our treatments. The electric fence consists of 46 m (50 yard) panels which interconnect to form a 0.5-m high continuous barrier 320 to 400 m in length. Details of the fence structure are referred to in McKillop *et al.* (1992). The fence was powered by a single 10,000-volt Gallagher energiser located in the middle of the fence line. The energiser was powered by a heavy duty 12-volt deep cycle battery. The charge was maintained by a Solarex MSX-18 solar panel. The voltage of the fence was measured at least twice each day to ensure it was operating effectively. Because of the sandy, non-wetting soils at our sites, we occasionally had problems obtaining a good earth, and this necessitated running an earth tape on the ground in front of the fence. We saturated the bush refuge area inside the electric fence with 120 to 180 conventional cage traps. An additional line of 20 traps placed outside the electric fence in the pasture feeding areas allowed us to capture any rabbits breaching the fence.

Analyses

We compared the trap types using analysis of variance (anova) for a random block design (Zar 1984). We examined these data in two ways: 1) using all rabbit captures (including recaptures) and 2) using first captures only. Each of these data sets were then further divided into subsets of adults and kittens for separate analyses. Interaction graphs were used to

examine whether site differences, or the interval of time between each trap session, had any affect on the success of each trap type. Comparisons between diced and whole carrot were made using Chi-square analyses, with those captures which occurred where no bait was provided excluded from the analyses.

The data obtained when the electric fence was used as a trapping aid, were used to examine trap success inside and outside the electric fence, the number of breaches of the electric fence, and the influence of fence voltages on these breaches. No statistical tests were applied to the electric fence capture data due to the large difference in trap nights (TN's) inside (bush refuge; 420 – 728 TN's) and outside (pasture feeding area; 60 – 80 TN's) the electric fence. Trap success (%) was calculated as: Trap Success (%) = (total captures/trap nights) x 100.

RESULTS

Comparison of Traps

The comparisons between the different trap types are presented in Table 1 and Fig. 2. Analyses based on all rabbit captures show that treadle traps, with or without shade cloth, caught more rabbits (P's <0.01; Table 1) than the corresponding arm traps. The response of kittens appeared to differ from that of adults; more kittens were caught in treadle traps with shade cloth than those without shade cloth (P <0.05; Table 1 and Fig. 2). The data for first captures only are not presented here but they gave similar results to the analyses of all rabbit captures. Figure 2 clearly shows that rabbit captures followed similar trends on each site, despite the differences in rabbit densities and the time of year that individual tests were conducted. Traps which had bait taken from them without capturing a rabbit and without being set off, are referred to as false captures in Table 1. Arm traps had significantly more instances (P < 0.05) of false captures than did the treadle traps.

By combining the data for real captures with the data for false captures (which in theory should have caught a rabbit), we were able to examine whether rabbits reacted similarly to both types of cage trap. There was no significant difference (TS vs AS P = 0.38, TNS vs ANS P = 0.18) in the type of trap rabbits chose to enter (Table 1), indicating that it was the trigger mechanism of the arm traps which was responsible for their poor efficacy rather than the failure of rabbits to enter these traps.

Presentation of Carrot Bait

Chi-square analyses of rabbit captures showed that diced carrot was significantly better than whole carrot (P <0.05), with 31 captures for whole carrot and 52 captures with diced carrot. Interestingly, there were 11 captures in the traps which contained no bait of any kind.

Electric Fence

The electric fence was a very efficient barrier to rabbits (Table 2). Spotlight counts of tagged rabbits indicated that we had caught all rabbits at this time. There were generally few breaches of the fence, as indicated by low rabbit capture rates for the traps in the pasture feeding areas. Even when fence voltage fell to as low as 2 kV, most rabbits were still retained behind the fence in the bush refuge area. There were some instances where

Table 2. Electric fence voltage and associated trap success (%) on the inside (refuge bush containment area) and the outside (pasture feeding areas) of the Flexinet electric fence for field trials carried out in the south west of Western Australia during 1992 and 1993.

	Inside fence			Outside fence				
Site-year	TN's	% Trap success	Actual captures	TN's	% Trap success	Actual captures	Fence voltage (kV) Mean	Range
2–1993	420	53.8	226	60	16.7	10	3.67	2.0–6.0
4–1993	426	14.8	63	60	0.0	0	6.93	5.8–8.1
5–1993	480	18.1	87	60	0.0	0	7.13	4.9–8.4
6–1993	480	15.2	73	60	0.0	0	7.25	5.8–8.4
10–1993	560	16.4	92	80	0.0	0	7.49	6.8–8.5
12–1993	480	19.4	93	80	1.3	1	6.32	4.8–7.5
1–1994	420	13.1	55	60	0.0	0	5.84	5.1–8.1
2–1994	728	44.0	320	80	3.8	3	5.93	5.3–6.3
3–1994	640	26.9	172	80	1.3	1	4.47	3.1–5.8
4–1994	728	23.2	169	80	8.8	7	4.51	2.6–6.2
5–1994	474	19.4	92	60	0.0	0	5.91	4.3–6.8
6–1994	474	15.6	74	60	0.0	0	5.42	4.3–6.6
9–1994	420	25.0	105	60	1.7	1	4.69	2.2–5.9
10–1994	584	22.3	130	80	3.8	3	5.17	3.0–8.4
12–1994	720	12.2	88	80	3.8	3	5.38	4.2–6.5

breaches, and some chewing of the conductive wires, occurred at the low voltages. The fence appeared to work best at voltages above 5 kV (Table 2). Use of the electric fence enabled the capture of 14 tagged and 28 tagged rabbits in 1993 and 1994, respectively, that had evaded capture through conventional trapping prior to the electric fence trapping. These values only include rabbits which could be positively differentiated from immigrant rabbits.

DISCUSSION

Comparison of Traps

Our study indicated that the wire mesh cage traps with a treadle mechanism are more effective in capturing rabbits of all ages than are similar traps with an arm mechanism. Our literature search failed to locate any other study comparing arm and treadle cage traps, but Slade *et al.* (1993) examined the effect of trap length on the trap success for rabbits. They found that shorter traps gave a greater number ($P < 0.0001$) of false captures (bait taken but no capture). Although all our traps were the same length, our study demonstrated that the arm traps had a significantly greater number of false captures. This, together with the fact that both trap types were acceptable to rabbits (Table 1), indicate that it is the arm mechanism that is responsible for the poor efficacy of the arm traps.

Chapman and Trethewey (1972) and Daly (1980) found age, sex and season to be determinants of the response to traps by cottontails *(Sylvilagus)* and European rabbits. They found

females were less trappable during the breeding season and juveniles were more trappable than adults. In our study, comparisons were carried out at the end of the breeding season and also in the summer months. Consequently, we are unable to directly compare our data with those of Chapman and Trethewey (1972) and Daly (1980). However, results from a similar trapping program at Wellstead (our unpublished data) support their general conclusions. Our current study showed that kittens were caught more often in traps which included shade cloth (Table 1). This information may be useful where juvenile rabbits need to be targeted.

Our study did not specifically address sensitivity of the trigger mechanisms of the two types of trap. Both trap types caught rabbits of all ages, but the arm mechanism appeared to be less sensitive than the treadle as it relies on being pushed, rather than being stepped on. Adult rabbits were observed reaching over the arm mechanism to obtain carrot without moving the arm sufficiently to set off the trap. Arm traps were also observed with the arm pushed toward to the front of the trap, effectively locking the trap open.

Presentation of Bait

Opinion on suitable baits for attracting rabbits to traps differs among authors. In a study in New South Wales Australia, Daly (1980) found that European rabbits preferred oats, showing little interest in carrots when offered a choice between these two baits. Chapman and Trethewey (1972) did not use any bait when trapping eastern cottontail *(Sylvilagus floridanus)* and brush rabbits *(S. bachmani)* in Oregon, USA. Bell *et al.* (1983) sprayed diced carrot with rabbit urine, but found no increase in the attractiveness of the carrot to European rabbits. Our preliminary investigation into the presentation of bait showed that rabbits preferred diced carrot to whole carrot. Thus, even in our habituated populations, dicing of carrot was necessary to obtain maxi-mum capture rates. Rowley (1959) tested carrot pieces of different weights and concluded that 5*g* carrot pieces (1 1/16 inch cubes) were the size preferred by European rabbits in a field-based feeding trial. Preference for a certain size of bait may relate to the ability of rabbits to pick up the bait and take it elsewhere if disturbed whilst feeding (Rowley 1959). Our diced carrot pieces (also cubes) had an average weight of 4.62 ± 1.29 g (n=40), and our rabbits were probably relat-ing to these in a manner similar to the rabbits observed by Rowley (1959).

Electric Fence Trapping

Flexinet electric fences are used extensively for containment of a variety of animals, but most of these studies have been confined to Europe. In Great Britain, McKillop *et al.* (1992) compared Flexinet electric fences with strained electrified wires, in relation to reducing crop damage by rabbits, and found Flexinet to be 100% effective in preventing rabbit damage. During our study, Flexinet also successfully prevented rabbits from gaining access to their feeding areas for the 3–5 days that the fence was in place, although a small number of breaches did occur when fence voltages became low (< 2 kV).

Conclusions

While caution is required when

extrapolating across species, we suggest that the treadle mechanism would be the best trigger mechanism to first consider when designing traps to catch other species of a size similar to that of rabbits. The addition of shade cloth may also be a worthy consideration for some species.

Flexinet electric fence has the potential to increase captures during trapping surveys of animals of a suitable size (e.g. some small macropods, possums, bandicoots), particularly where absolute numbers of animals need to be caught. It has also been used successfully to assist with rabbit control programs in and around small stands of remnant bush in Western Australia, where it has been effective in directing European rabbits onto poison oat trails (M. Robinson, APB, personal communication). Although the initial cost outlay is relatively high (a 50 yard (46 m) roll in 1995 cost US $190), the portable nature of Flexinet has much appeal. Using Flexinet as an aid to vertebrate pest control may be benefical during the conservation of small, but important stands of remnant vegetation, and a study investigating the long term efficacy and cost benefits of this approach would be worthwhile. Flexinet may also prove useful in mammalian conservation where it could be used to confine suitably sized mammals during the initial stages of reintroductions and/or to confine those species whose ability to provide parental care is reduced following human disturbance.

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